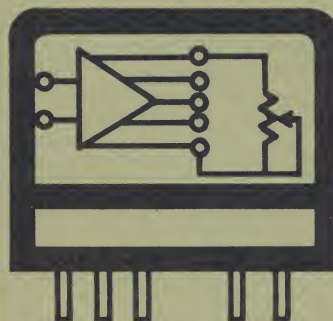
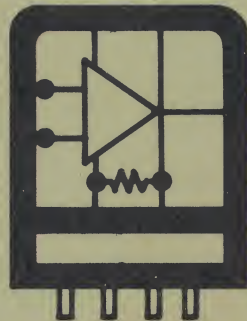
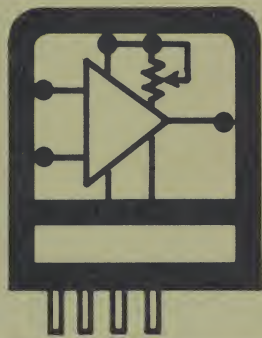


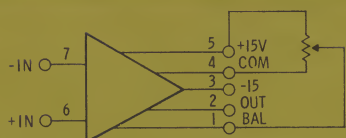
# Operational Amplifiers

**FAIRCHILD**

CONTROLS

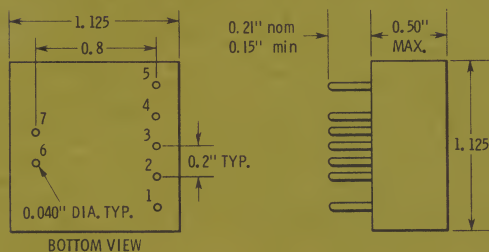


## CASE SIZE AND CONFIGURATIONS



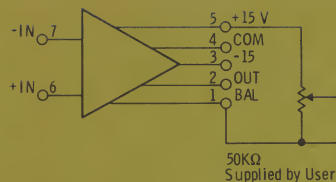
10 to 50 K $\Omega$ \*  
Supplied by User

\* If offset voltage adjustment is not needed, the potentiometer can be deleted and Pin 1 left open.

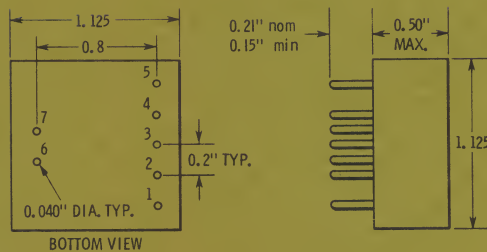


ADO — 19, 26B, 27B, 29B

Dimensions in inches

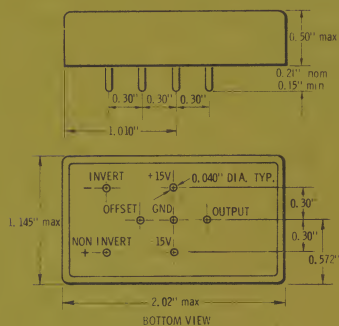
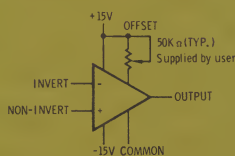


50K $\Omega$   
Supplied by User



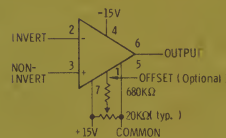
ADO — 44, and 45

Dimensions in inches



ADO — 40, and 41

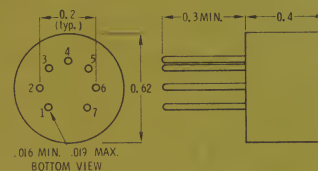
Dimensions in inches



1. Offset connection (See adjacent note)
2. Inverting input
3. Non-inverting input
4. -15V
5. GND
6. Output
7. +15V

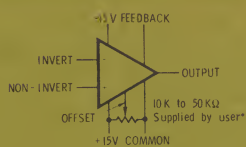
The missing lead (#8) corresponds to the tab position in the  $\mu$ A709. Lead connections are identical to the  $\mu$ A709 except compensation is provided internally so lead #1 should be unconnected unless used for offset compensation. Also lead #5 should be grounded.

Note: Offset compensation may be connected as shown with some degradation in specifications, particularly gain.

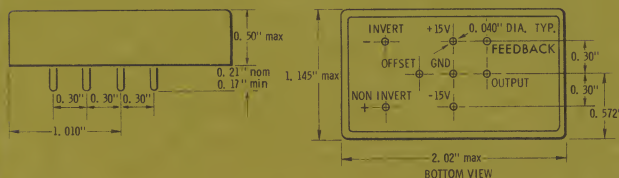


ADO — 49A, and 49C

Dimensions in inches

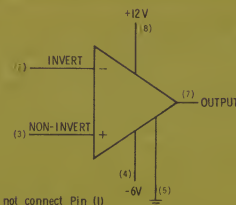


If offset voltage adjustment is not needed, the potentiometer can be deleted and the offset pin left open. For capacitive load >2000 pF use separate output and feedback terminals.



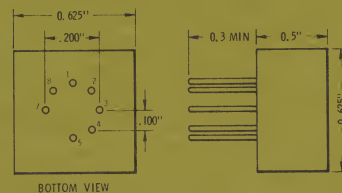
ADO — 20, 21, 22, 23, 24, and 25

Dimensions in inches



Do not connect Pin (1)

Pin 8 corresponds to the tab position on the  $\mu$ A702. Lead connections are identical to the  $\mu$ A702 except that pin 1 should be floating and pin 5 grounded. Designed for 5K $\Omega$  source impedance.



ADO — 52

Dimensions in inches



| GENERAL PURPOSE                                   |                                                        |                                                                  |                                                                  |                                               |                                               |                                                                 |                                                                 |                                                                 |
|---------------------------------------------------|--------------------------------------------------------|------------------------------------------------------------------|------------------------------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------------------------|-----------------------------------------------------------------|-----------------------------------------------------------------|
| SPECIFICATIONS                                    | Economy                                                |                                                                  |                                                                  |                                               | 20 mA Output                                  |                                                                 |                                                                 |                                                                 |
|                                                   | ADO-44                                                 | ADO-45                                                           | ADO-41                                                           | ADO-40<br>Low Drift                           | ADO-49C<br>( $\mu$ A 709C type)               | ADO-49A<br>( $\mu$ A 709 type)                                  | ADO-52C<br>( $\mu$ A 702C type)                                 | ADO-52A<br>( $\mu$ A 702 type)                                  |
| At 25°C ambient and rated supply unless specified |                                                        |                                                                  |                                                                  |                                               |                                               |                                                                 |                                                                 |                                                                 |
| GAIN                                              | DC Voltage Gain (open loop)                            | 10,000 (typ)<br>7,000 (min)                                      | 100,000 (typ)<br>75,000 (min)                                    | 75,000 (min)                                  | 75,000 (min)                                  | 40,000 (typ)<br>25,000 (min)                                    | 40,000 (typ)<br>25,000 (min)                                    | 3,400 (typ)<br>2,000 (min)                                      |
|                                                   | Gain-Bandwidth Product                                 | 550 KHz (typ)<br>450 KHz (min)                                   | 2.0 MHz (typ)<br>1.5 MHz (min)                                   | 1.8 MHz (min)                                 | 1.8 MHz (min)                                 | 1 MHz (typ)<br>500 KHz (min)                                    | 1 MHz (typ)<br>500 KHz (min)                                    | 20 MHz <sup>2</sup>                                             |
|                                                   | Gain Roll-Off (typ.)                                   | 6 db/octave                                                      | 6 db/octave                                                      | 6 db/octave                                   | 6 db/octave                                   | 6 db/octave                                                     | 6 db/octave                                                     | 6 db/octave                                                     |
|                                                   | Slewing Rate                                           | 0.2 V/ $\mu$ sec (min)                                           | 1.4 V/ $\mu$ sec (typ)<br>1.1 V/ $\mu$ sec (min)                 | 0.6 V/ $\mu$ sec (min)                        | 0.6 V/ $\mu$ sec (min)                        | 0.2 V/ $\mu$ sec (min)                                          | 0.2 V/ $\mu$ sec (min)                                          | 30 V/ $\mu$ s (typ)<br>15 V/ $\mu$ s (min)                      |
| INPUT                                             | Initial Equivalent Offset Voltage (adjustable to zero) | —                                                                | —                                                                | —                                             | 5 mV (max) <sup>5</sup>                       | 2.0 mV (typ) <sup>4</sup><br>7.5 mV (max)                       | 1.0 mV (typ) <sup>4</sup><br>5.0 mV (max)                       | 2.0 mV (typ)<br>5.0 mV (max)                                    |
|                                                   | Input Bias Current                                     | 45 nA (typ)<br>100 nA (max)                                      | 60 nA (typ)<br>100 nA (max)                                      | 45 nA (max)                                   | 45 nA (max)                                   | 0.3 $\mu$ A (typ)<br>1.5 $\mu$ A (max)                          | 0.2 $\mu$ A (typ)<br>0.5 $\mu$ A (max)                          | 4.0 $\mu$ A (typ)<br>7.5 $\mu$ A (max)                          |
|                                                   | Input Difference Current                               | 10 nA (typ)                                                      | 10 nA (typ)                                                      | 10 nA (max)                                   | 10 nA (max)                                   | 100 nA (typ)<br>500 nA (max)                                    | 100 nA (typ)<br>200 nA (max)                                    | 0.7 $\mu$ A (typ)<br>2.0 $\mu$ A (max)                          |
|                                                   | Equivalent Drift vs. Temp. <sup>1</sup> Voltage        | 20 $\mu$ V/ $^{\circ}$ C (typ)<br>40 $\mu$ V/ $^{\circ}$ C (max) | 10 $\mu$ V/ $^{\circ}$ C (typ)<br>20 $\mu$ V/ $^{\circ}$ C (max) | 40 $\mu$ V/ $^{\circ}$ C (max)                | 20 $\mu$ V/ $^{\circ}$ C (max)                | 5 $\mu$ V/ $^{\circ}$ C (typ)<br>20 $\mu$ V/ $^{\circ}$ C (max) | 3 $\mu$ V/ $^{\circ}$ C (typ)<br>20 $\mu$ V/ $^{\circ}$ C (max) | 5 $\mu$ V/ $^{\circ}$ C (typ)<br>20 $\mu$ V/ $^{\circ}$ C (max) |
|                                                   | Current                                                | 2 nA/ $^{\circ}$ C (typ)<br>5 nA/ $^{\circ}$ C (max)             | 1.5 nA/ $^{\circ}$ C (typ)<br>2 nA/ $^{\circ}$ C (max)           | 2 nA/ $^{\circ}$ C (max)                      | 2 nA/ $^{\circ}$ C (max)                      | —                                                               | —                                                               | —                                                               |
|                                                   | Equivalent Drift vs. Time Voltage (max.)               | 200 $\mu$ V/24 hr (typ)                                          | 50 $\mu$ V/100 hr (typ)                                          | 50 $\mu$ V/24 hr                              | 50 $\mu$ V/24 hr                              | —                                                               | —                                                               | —                                                               |
|                                                   | Current (max.)                                         | 5 nA/24 hr                                                       | 5 nA/24 hr                                                       | 5 nA/24 hr                                    | 5 nA/24 hr                                    | —                                                               | —                                                               | —                                                               |
|                                                   | Drift vs. Supply                                       | 200 $\mu$ V/V (typ)                                              | 200 $\mu$ V/V (typ)                                              | 5 nA/V (max)<br>100 $\mu$ V/V (max)           | 5 nA/V (max)<br>100 $\mu$ V/V (max)           | 200 $\mu$ V/V (max)                                             | 150 $\mu$ V/V (max)                                             | 60 $\mu$ V/V (typ)<br>300 $\mu$ V/V (max)                       |
|                                                   | Equivalent Noise (max.)                                | 2.7 $\mu$ V rms (typ)<br>5 $\mu$ V rms (max)<br>10 Hz to 4 KHz   | 3 $\mu$ V rms (typ)<br>5 $\mu$ V rms (max)<br>10 Hz to 10 KHz    | 5 $\mu$ V rms<br>10 Hz to 2 KHz               | 5 $\mu$ V rms<br>10 Hz to 2 KHz               | —                                                               | —                                                               | —                                                               |
|                                                   | Input Impedance (min.) Differential                    | 200 K $\Omega$ (diff)<br>10 M $\Omega$ (C.M.)                    | 200 K $\Omega$ (diff)<br>10 M $\Omega$ (C.M.)                    | 300 K $\Omega$ (diff)<br>20 M $\Omega$ (C.M.) | 300 K $\Omega$ (diff)<br>20 M $\Omega$ (C.M.) | 250 K $\Omega$ (typ)<br>50 K $\Omega$ (min)                     | 400 K $\Omega$ (typ)<br>150 K $\Omega$ (min)                    | 25 K $\Omega$ (typ)<br>10 K $\Omega$ (min)                      |
|                                                   | Input Voltage (max.) Differential                      | $\pm 5$ V                                                        | $\pm 15$ V <sup>3</sup>                                          | $\pm 15$ V <sup>3</sup>                       | $\pm 15$ V <sup>3</sup>                       | $\pm 5$ V                                                       | $\pm 5$ V                                                       | — <sup>3</sup>                                                  |
|                                                   | Common Mode                                            | $\pm 7.5$ V (typ)<br>$\pm 5$ V (min)                             | $\pm 10$ V (min)                                                 | $\pm 10$ (min)                                | $\pm 10$ (min)                                | $\pm 10$ V (typ)<br>$\pm 8$ V (min)                             | $\pm 10$ V (typ)<br>$\pm 8$ V (min)                             | $\pm 2.5$ V (min)                                               |
|                                                   | Common Mode Rejection                                  | 74 db (typ)                                                      | 80 db (typ)                                                      | 86 db (min)                                   | 86 db (min)                                   | 86 db (typ)<br>66 db (min)                                      | 86 db (typ)<br>66 db (min)                                      | 80 db (typ)<br>70 db (min)                                      |
|                                                   | Output Voltage Swing (min.)                            | $\pm 10$ V                                                       | $\pm 10$ V                                                       | $\pm 10$ V                                    | $\pm 10$ V                                    | $\pm 10$ V                                                      | $\pm 10$ V                                                      | 8 V p-p                                                         |
| OUTPUT                                            | Load Current (min.)                                    | $\pm 1$ mA                                                       | $\pm 5$ mA                                                       | 20 mA                                         | 20 mA                                         | $\pm 5$ mA                                                      | $\pm 5$ mA                                                      | $\pm 3$ mA                                                      |
|                                                   | Output Impedance (open loop) (typ.)                    | 50 $\Omega$                                                      | 50 $\Omega$                                                      | 50 $\Omega$                                   | 50 $\Omega$                                   | 200 $\Omega$                                                    | 200 $\Omega$                                                    | 500 $\Omega$ (max)                                              |
|                                                   | Max. Freq. for full output                             | 1 kHz (typ)                                                      | 20 kHz (typ)                                                     | 10kHz (min)                                   | 10kHz (min)                                   | 3 kHz (min)                                                     | 3 kHz (min)                                                     | 600 kHz (typ)                                                   |
|                                                   | Capacitive Loading (min.) (X closed loop gain)         | 10,000 pf                                                        | 10,000 pf                                                        | 5,000 pf                                      | 5,000 pf                                      | 1,000 pf                                                        | 1,000 pf                                                        | 300 pf                                                          |
| POWER                                             | Supply Voltage (range)                                 | $\pm 12$ to $\pm 18$ V                                           | $\pm 12$ to $\pm 18$ V                                           | $\pm 12$ to $\pm 18$ V                        | $\pm 12$ to $\pm 18$ V                        | $\pm 10$ to $\pm 17$ V                                          | $\pm 10$ to $\pm 17$ V                                          | —                                                               |
|                                                   | (rated)                                                | $\pm 15$ V                                                       | $\pm 15$ V                                                       | $\pm 15$ V                                    | $\pm 15$ V                                    | $\pm 15$ V                                                      | $\pm 15$ V                                                      | $\pm 12$ V, —6 V                                                |
|                                                   | Supply Current (quiescent)                             | 5 mA                                                             | 3 mA                                                             | 5 mA                                          | 5 mA                                          | 3 mA (typ)<br>7 mA (max)                                        | 3 mA (typ)<br>7 mA (max)                                        | 18 mA (max)                                                     |
| TEMP.                                             | Temperature Operating                                  | —25° to +85°C                                                    | —25° to +85°C                                                    | —25° to +85°C                                 | —25° to +85°C                                 | 0° to +70°C                                                     | —55° to +125°C                                                  | 0° to +70°C                                                     |
|                                                   | Storage                                                | —55° to +100°C                                                   | —55° to +125°C                                                   | —55° to +125°C                                | —55° to +125°C                                | —65° to +150°C                                                  | —65° to +150°C                                                  | —65° to +150°C                                                  |
| PRICE                                             | Package                                                | SEE ADJACENT PAGE                                                |                                                                  |                                               |                                               |                                                                 |                                                                 |                                                                 |
|                                                   | Quantity (1-9 pcs.)                                    | \$11.50                                                          | \$15                                                             | \$38                                          | \$45                                          | \$20                                                            | \$28                                                            | \$20                                                            |
|                                                   | Mating Socket (1-9 pcs.)                               | \$2.75                                                           | \$2.75                                                           | \$2.75                                        | \$2.75                                        | —                                                               | —                                                               | —                                                               |

<sup>1</sup> Averaged over specified temperature range

<sup>2</sup> 0-60°C; For mil temperature range —55°C to +125°C, consult factory

<sup>3</sup> For mil temperature range, consult factory

<sup>4</sup> If offset voltage adjustment is not needed, the potentiometer can be deleted and the offset pin left unconnected.

<sup>5</sup> With offset shorted to +15V

<sup>6</sup> Input capacitance 4 pf (typ)



|                          | FET INPUT—WIDE BANDWIDTH                            |                                                                                                 |                                                          |                                                          |                                   |                                  |                                  |                                   |                                  |                                  |
|--------------------------|-----------------------------------------------------|-------------------------------------------------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------|-----------------------------------|----------------------------------|----------------------------------|-----------------------------------|----------------------------------|----------------------------------|
|                          | FET INPUT—I.C. COMBINATIONS                         |                                                                                                 |                                                          |                                                          | 2.5 mA Output                     |                                  |                                  | 20 mA Output                      |                                  |                                  |
|                          | ADO-19<br>Low Cost                                  | ADO-29B                                                                                         | ADO-27B<br>Low Drift                                     | ADO-26B<br>Lowest Drift                                  | ADO-21<br>Economy                 | ADO-23                           | ADO-25<br>Low Drift              | ADO-20<br>Economy                 | ADO-22                           | ADO-24<br>Low Drift              |
| 52A<br>Grade<br>(2 type) |                                                     |                                                                                                 |                                                          |                                                          |                                   |                                  |                                  |                                   |                                  |                                  |
| (typ)                    | 140,000 (typ)                                       | 140,000 (typ)                                                                                   | 140,000 (typ)                                            | 140,000 (typ)                                            | 50,000 (typ)                      | 50,000 (typ)                     | 50,000 (typ)                     | 50,000 (typ)                      | 50,000 (typ)                     | 50,000 (typ)                     |
| s (min)                  | 70,000 (min)                                        | 100,000 (min)                                                                                   | 100,000 (min)                                            | 100,000 (min)                                            | 25,000 (min)                      | 25,000 (min)                     | 25,000 (min)                     | 25,000 (min)                      | 25,000 (min)                     | 25,000 (min)                     |
| Hz <sup>8</sup>          | 1 MHz (typ)<br>250 KHz (min)                        | 1.5 MHz (typ)<br>750 KHz (min)                                                                  | 1.5 MHz (typ)<br>750 KHz (min)                           | 1.5 MHz (typ)<br>750 MHz (min)                           | 10 MHz (typ)<br>5 MHz (min)       | 10 MHz (typ)<br>5 MHz (min)      | 10 MHz (typ)<br>5 MHz (min)      | 10 MHz (typ)<br>5 MHz (min)       | 10 MHz (typ)<br>5 MHz (min)      | 10 MHz (typ)<br>5 MHz (min)      |
| octave                   | 6 db/octave                                         | 6 db/octave                                                                                     | 6 db/octave                                              | 6 db/octave                                              | 6 db/octave                       | 6 db/octave                      | 6 db/octave                      | 6 db/octave                       | 6 db/octave                      | 6 db/octave                      |
| s (typ)                  | 2 V/μsec (typ)                                      | 2 V/μsec (typ)                                                                                  | 2 V/μsec (typ)                                           | 2 V/μsec (typ)                                           | 15 V/μsec (typ)                   | 15 V/μsec (typ)                  | 15 V/μsec (typ)                  | 15 V/μsec (typ)                   | 15 V/μsec (typ)                  | 15 V/μsec (typ)                  |
| (min)                    | 0.5 V/μsec (min)                                    | 1 V/μsec (min)                                                                                  | 1 V/μsec (min)                                           | 1 V/μsec (min)                                           | 10 V/μsec (min)                   | 10 V/μsec (min)                  | 10 V/μsec (min)                  | 10 V/μsec (min)                   | 10 V/μsec (min)                  | 10 V/μsec (min)                  |
| V (typ)                  |                                                     |                                                                                                 |                                                          |                                                          |                                   |                                  |                                  |                                   |                                  |                                  |
| (max)                    | 5 mV (max) <sup>4</sup>                             | —0.3, +0.7<br>mV (max) <sup>4</sup>                                                             | —0.3, +0.7<br>mV (max) <sup>4</sup>                      | —0.3, +0.7<br>mV (max) <sup>4</sup>                      | 5 mV (max) <sup>4</sup>           | 3 mV (max) <sup>4</sup>          | 2 mV (max) <sup>4</sup>          | 5 mV (max) <sup>4</sup>           | 3 mV (max) <sup>4</sup>          | 2 mV (max) <sup>4</sup>          |
| (typ)                    | 20 pA (typ)                                         | 10 pA (typ)                                                                                     | 10 pA (typ)                                              | 10 pA (typ)                                              | 10 pA (typ)                       | 10 pA (typ)                      | 10 pA (typ)                      | 10 pA (typ)                       | 10 pA (typ)                      | 10 pA (typ)                      |
| (max)                    | 100 pA (max)                                        | 50 pA (max)                                                                                     | 20 pA (max)                                              | 20 pA (max)                                              | 50 pA (max)                       | 50 pA (max)                      | 50 pA (max)                      | 50 pA (max)                       | 50 pA (max)                      | 50 pA (max)                      |
| (typ)                    |                                                     |                                                                                                 |                                                          |                                                          |                                   |                                  |                                  |                                   |                                  |                                  |
| (max)                    | — —                                                 | — —                                                                                             | — —                                                      | — —                                                      | — —                               | — —                              | — —                              | — —                               | — —                              | — —                              |
| C (typ)                  |                                                     |                                                                                                 |                                                          |                                                          |                                   |                                  |                                  |                                   |                                  |                                  |
| C (max)                  | 60 μV/°C (max) <sup>2</sup>                         | 25 μV/°C (typ) <sup>2</sup><br>50 μV/°C (max) <sup>2</sup>                                      | 4 μV/°C (typ) <sup>2</sup><br>5 μV/°C (max) <sup>2</sup> | 1 μV/°C (typ) <sup>2</sup><br>2 μV/°C (max) <sup>2</sup> | 50 μV/°C (typ)<br>100 μV/°C (max) | 25 μV/°C (typ)<br>50 μV/°C (max) | 10 μV/°C (typ)<br>20 μV/°C (max) | 50 μV/°C (typ)<br>100 μV/°C (max) | 25 μV/°C (typ)<br>50 μV/°C (max) | 10 μV/°C (typ)<br>20 μV/°C (max) |
| —                        | Doubles<br>every 10°C                               | Doubles<br>every 10°C                                                                           | Doubles<br>every 10°C                                    | Doubles<br>every 10°C                                    | Doubles<br>every 10°C             | Doubles<br>every 10°C            | Doubles<br>every 10°C            | Doubles<br>every 10°C             | Doubles<br>every 10°C            | Doubles<br>every 10°C            |
| —                        | — —                                                 | 25 μV/8 hr                                                                                      | 10 μV/8 hr                                               | 5 μV/8 hr                                                | 50 μV/8 hr                        | 25 μV/8 hr                       | 25 μV/8 hr                       | 50 μV/8 hr                        | 25 μV/8 hr                       | 25 μV/8 hr                       |
| —                        | — —                                                 | — —                                                                                             | — —                                                      | — —                                                      | — —                               | — —                              | — —                              | — —                               | — —                              | — —                              |
| V (typ)                  |                                                     |                                                                                                 |                                                          |                                                          |                                   |                                  |                                  |                                   |                                  |                                  |
| V (max)                  | 1000 μV/V (typ)                                     | 100 μV/V (max)                                                                                  | 100 μV/V (max)                                           | 100 μV/V (max)                                           | 200 μV/V (typ)                    | 200 μV/V (typ)                   | 200 μV/V (typ)                   | 200 μV/V (typ)                    | 200 μV/V (typ)                   | 200 μV/V (typ)                   |
| —                        | 5 μV rms (typ)<br>12 μV rms (max)<br>10 Hz to 1 KHz | 2 μV p-p (typ), 5 μV p-p (max) 0.1 Hz to 10 Hz<br>3 μV rms (typ), 6 μV rms (max) 10 Hz to 1 KHz |                                                          |                                                          | 8 μV rms<br>10 Hz to 10 kHz       | 8 μV rms<br>10 Hz to 10 kHz      | 8 μV rms<br>10 Hz to 10 kHz      | 8 μV rms<br>10 Hz to 10 kHz       | 8 μV rms<br>10 Hz to 10 kHz      | 8 μV rms<br>10 Hz to 10 kHz      |
| Q (typ)                  |                                                     | 10 <sup>11</sup> Ω (typ)                                                                        | 10 <sup>12</sup> Ω (typ)                                 | 10 <sup>12</sup> Ω (typ)                                 | 10 <sup>11</sup> Ω (diff)         | 10 <sup>11</sup> Ω (diff)        | 10 <sup>11</sup> Ω (diff)        | 10 <sup>11</sup> Ω (diff)         | 10 <sup>11</sup> Ω (diff)        | 10 <sup>11</sup> Ω (diff)        |
| Q (min)                  | 10 <sup>10</sup> Ω (min)                            | 10 <sup>10</sup> Ω (min) <sup>6</sup>                                                           | 10 <sup>11</sup> Ω (min) <sup>6</sup>                    | 10 <sup>11</sup> Ω (min) <sup>6</sup>                    | 4 pf (typ)                        | 4 pf (typ)                       | 4 pf (typ)                       | 4 pf (typ)                        | 4 pf (typ)                       | 4 pf (typ)                       |
| —                        | — —                                                 | — —                                                                                             | — —                                                      | — —                                                      | — —                               | — —                              | — —                              | — —                               | — —                              | — —                              |
| (min)                    | +8 V (min)<br>—10 V (min)                           | +5 V (min)<br>—10 V (min)                                                                       | +5 V (min)<br>—10 V (min)                                | +5 V (min)<br>—10 V (min)                                | ±10 V (min)                       | ±10 V (min)                      | ±10 V (min)                      | ±10 V (min)                       | ±10 V (min)                      | ±10 V (min)                      |
| (typ)                    |                                                     |                                                                                                 |                                                          |                                                          |                                   |                                  |                                  |                                   |                                  |                                  |
| (min)                    | 60 db (typ)                                         | 86 db (min)                                                                                     | 86 db (min)                                              | 86 db (min)                                              | 72 db (typ)<br>60 db (min)        | 72 db (typ)<br>60 db (min)       | 72 db (typ)<br>60 db (min)       | 72 db (typ)<br>60 db (min)        | 72 db (typ)<br>60 db (min)       | 72 db (typ)<br>60 db (min)       |
| o-p                      | ±10 V                                               | ±10 V                                                                                           | ±10 V                                                    | ±10 V                                                    | ±10 V                             | ±10 V                            | ±10 V                            | ±10 V                             | ±10 V                            | ±10 V                            |
| mA                       | ±5 mA                                               | ±5 mA                                                                                           | ±5 mA                                                    | ±5 mA                                                    | 2.5 mA                            | 2.5 mA                           | 2.5 mA                           | 20 mA                             | 20 mA                            | 20 mA                            |
| (max)                    | 500 Ω                                               | 450 Ω                                                                                           | 450 Ω                                                    | 450 Ω                                                    | 150 Ω                             | 150 Ω                            | 150 Ω                            | 150 Ω                             | 150 Ω                            | 150 Ω                            |
| (typ)                    | 20 kHz (typ)                                        | 30 kHz (typ)                                                                                    | 30 kHz (typ)                                             | 30 kHz (typ)                                             | 150 kHz (min)                     | 150 kHz (min)                    | 150 kHz (min)                    | 150 kHz (min)                     | 150 kHz (min)                    | 150 kHz (min)                    |
| pf                       | 1,000 pf                                            | 1,000 pf                                                                                        | 1,000 pf                                                 | 1,000 pf                                                 | >2000 pf <sup>7</sup>             | >2000 pf <sup>7</sup>            | >2000 pf <sup>7</sup>            | >2000 pf <sup>7</sup>             | >2000 pf <sup>7</sup>            | >2000 pf <sup>7</sup>            |
| —                        | ±12 to ±20V                                         | ±12 to ±18 V                                                                                    | ±12 to ±18 V                                             | ±12 to ±18 V                                             | ±12 to ±18 V                      | ±12 to ±18 V                     | ±12 to ±18 V                     | ±12 to ±18 V                      | ±12 to ±18 V                     | ±12 to ±18 V                     |
| —6 V                     | ±15 V                                               | ±15 V                                                                                           | ±15 V                                                    | ±15 V                                                    | ±15 V                             | ±15 V                            | ±15 V                            | ±15 V                             | ±15 V                            | ±15 V                            |
| (max)                    | 3.5 mA (typ)<br>7 mA (max)                          | 4 mA (typ)<br>8 mA (max)                                                                        | 4 mA (typ)<br>8 mA (typ)                                 | 4 mA (typ)<br>8 mA (max)                                 | 12mA (typ)<br>18 mA (max)         | 12mA (typ)<br>18 mA (max)        | 12mA (typ)<br>18 mA (max)        | 12mA (typ)<br>18 mA (max)         | 12mA (typ)<br>18 mA (max)        | 12mA (typ)<br>18 mA (max)        |
| +125°C                   | —25° to +85°C <sup>3</sup>                          | —25° to +85°C <sup>3</sup>                                                                      | —25° to +85°C <sup>3</sup>                               | —25° to +85°C <sup>3</sup>                               | —25 to +85°C                      | —25 to +85°C                     | —25 to +85°C                     | —25 to +85°C                      | —25 to +85°C                     | —25 to +85°C                     |
| +150°C                   | —55° to +125°C                                      | —55° to +125°C                                                                                  | —55° to +125°C                                           | —55° to +125°C                                           | —55 to +85°C                      | —55 to +85°C                     | —55 to +85°C                     | —55 to +85°C                      | —55 to +85°C                     | —55 to +85°C                     |
| —                        | SEE ADJACENT PAGE                                   |                                                                                                 |                                                          |                                                          |                                   |                                  |                                  |                                   |                                  |                                  |
| \$                       | \$29                                                | \$45                                                                                            | \$70                                                     | \$98                                                     | \$65                              | \$75                             | \$85                             | \$85                              | \$95                             | \$105                            |
| —                        | \$2.75                                              | \$2.75                                                                                          | \$2.75                                                   | \$2.75                                                   | \$4.00                            | \$4.00                           | \$4.00                           | \$4.00                            | \$4.00                           | \$4.00                           |

<sup>7</sup> Capacitive loading >4000 pf with special feedback terminal

<sup>8</sup> Designed for 5 KΩ source impedance

<sup>9</sup> Input protection diodes

## GENERAL PURPOSE

This family of low cost, general purpose units includes 1 mA, 5 mA and 20 mA output versions. Hidden quality, such as the diode input protection and short circuit output protection of the ADO-45, makes these excellent units for a wide variety of applications.

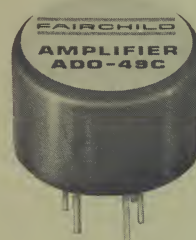
## COMPENSATED I.C.'s Space-saving packages

The ADO-49s, based on the  $\mu$ A709 series, feature built-in frequency compensation matched to the individual I.C.'s, 6 db/octave rolloff to assure stability, filters to decouple power supplies, and short circuit protection.

The ADO-52s, based on the  $\mu$ A702 series, add greater common mode voltage range, input protection, larger output swing and power line filters to the basic I.C.'s.



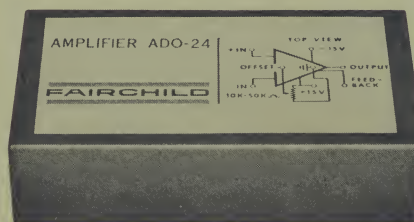
ADO — 45



ADO — 49C



ADO — 26B



ADO — 24

## FET INPUT — I.C. COMBINATIONS Ultra low drift

These units feature dual FET inputs followed by I.C. stages. Two units, the ADO-26B and ADO-27B, use a patented compensation technique to achieve ultra low drifts guaranteed  $<2$  and  $<5 \mu\text{V}/^\circ\text{C}$  respectively. These also guarantee 86 db CMRR and 100  $\mu\text{V}/\text{V}$  supply rejection.

The ADO-19 utilizes the FET — I.C. combination to achieve good performance at a moderate price, \$29.

## FET INPUT — WIDE BANDWIDTH Drives large capacitive loads

These FET input, fast slew rate, 6 db/octave amplifiers have separate feedback pins that allow the amplifiers to be used conventionally or to drive large capacitive loads. Both 2.5 and 20 mA output versions are available.





## ENGINEERING REPRESENTATIVES

1. **Vector Sales, Inc.**  
Belmont, Massachusetts 02178  
774 Pleasant Street  
Phone: (617) 489-1400
2. **Ossmann Component Sales Corp.**  
Rochester, New York 14623  
39 Saginaw Drive  
Phone: (716) 442-3290  
Syracuse, New York 13211  
132 Pickard Building  
Phone: (315) 454-4477  
Vestal, New York 13850  
1901 Vestal Parkway  
Phone: (607) 785-9949  
Red Hook, New York 12571  
77 Kelly Road  
Phone: (914) 297-7773
3. **HRC Associates**  
P. O. Box 44  
Manhasset, New York 11030  
Phone: (516) 627-4644
4. **Stemler Associates, Inc.**  
Baltimore, Maryland 21207  
6707 Whitestone Road  
Phone: (301) 944-8262  
Cherry Hill, New Jersey 08034  
P. O. Box 287  
Phone: (609) 966-4070  
Paoli, Pennsylvania 19301  
P. O. Box 711  
Phone: (215) 644-3477
5. **Reynolds & Associates, Inc.**  
Eau Gallie, Florida 32935  
P. O. Box 1043  
Phone: (305) 727-3205  
Ft. Lauderdale, Florida 33314  
161 S. W. 75th Avenue  
Phone: (305) 581-6611  
Orlando, Florida 32806  
P. O. Box 8877  
Phone: (305) 424-3836  
Atlanta, Georgia 30305  
175 W. Wieuca Road, Suite 139  
Phone: (404) 252-5360
6. **WKM Associates, Inc.**  
Cleveland, Ohio 44129  
6741 Ridge Road  
Phone: (216) 885-5616  
Dayton, Ohio 45429  
5335 Far Hills Avenue  
Phone: (513) 434-7500  
Pittsburgh, Pennsylvania 15236  
90 Clairton Boulevard  
Phone: (412) 892-2953  
Detroit, Michigan 48234  
1474 East Outer Drive  
Phone: (313) 892-2500
7. **Fiat Engineering Associates**  
Bellwood, Illinois 60104  
5133 St. Charles Road  
Phone: (312) 547-6200  
Muncie, Indiana 47305  
P. O. Box 1165  
Phone: (317) 282-5676
8. **Fairchild Controls**  
Mountain View, California 94040  
423 National Avenue  
Phone: (415) 962-3833
9. **Fairchild Controls**  
Mountain View, California 94040  
423 National Avenue  
Phone: (415) 962-3833
10. **Dannemiller-Smith, Inc.**  
Dallas, Texas 75235  
2720 W. Mockingbird Lane  
Phone: (214) 357-8249  
Houston, Texas 77036  
5760 Rice Avenue  
Phone: (713) 668-4461
11. **Fairchild Controls**  
Mountain View, California 94040  
423 National Avenue  
Phone: (415) 962-3833
12. **Hyer Electronics**  
Englewood, Colorado 80110  
Denver Technological Center  
7895 E. Prentice Avenue  
Phone: (303) 771-5285  
Albuquerque, New Mexico 87108  
210 LaVeta Drive N. E.  
Phone: (505) 265-5767  
Phoenix, Arizona 85013  
301 West Indian School Road  
Suite 126  
Phone: (602) 264-0291  
Salt Lake City, Utah 84111  
445 E. 2nd South, Suite 103  
Phone: (801) 363-6773
13. **Brett Engineering Associates**  
Seattle, Washington 98126  
2610 38th Avenue S. W.  
Phone: (206) 935-1062
14. **GBH Associates**  
Mountain View, California 94040  
P. O. Box 1150  
Phone: (415) 969-9770
15. **CDH Associates**  
Encino, California  
18075 Ventura Boulevard, Suite 212  
Phone: (213) 345-1644
16. **BRH Associates Limited**  
Montreal, Quebec  
6338 Victoria Avenue  
Phone: (514) 733-5331  
Willowdale, Ontario  
184 Finch Avenue, West, Suite 21  
Phone: (416) 223-4008  
Ottawa, Ontario  
1300 Carling Avenue, Suite 208  
Phone: (613) 728-0113  
North Vancouver, B. C.  
P. O. Box 69  
Phone: (604) 985-6221

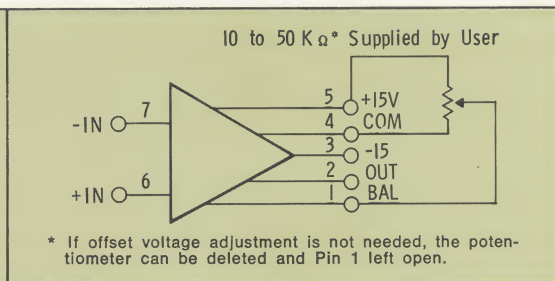
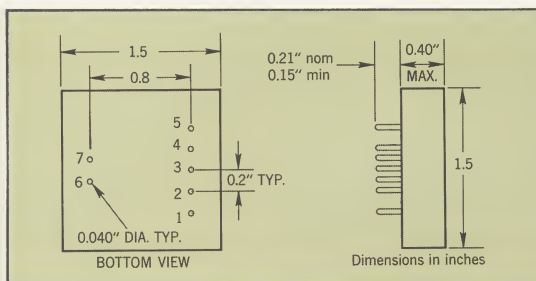
**FAIRCHILD**  
CONTROLS

MODULAR PRODUCTS / 423 NATIONAL AVENUE, MOUNTAIN VIEW, CALIFORNIA 94040 / (415) 962-3833 / TWX: 910-379-6438

FAIRCHILD CONTROLS IS A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

# LOW POWER FET OPERATIONAL AMPLIFIER/ADO-39

**FAIRCHILD**  
CONTROLS



## FEATURES

- Ultra-low Power Consumption
- Wide Power Supply Range  
 $\pm 4.5$  to  $\pm 20V$
- FET Input
- Output Short Circuit Protection

## DESCRIPTION

The ADO-39 is an FET input operational amplifier designed for exceptionally low power consumption. The amplifier operates from  $\pm 4.5$  to  $\pm 20V$  with a quiescent current drain of less than  $200 \mu A$  to make the power consumption less than 1.8 to 8 mW.

Many quality features are built into the ADO-39, including power line filter capacitors and output short circuit protection. The low profile construction, 0.4" high, permits close spacing of circuit boards.

Quality performance, combined with low power drain, make the ADO-39 particularly attractive for use in battery powered equipment — medical, industrial and aerospace.

## SPECIFICATIONS: (at 25°C and $\pm 15V$ supply voltage unless noted)

|        |                                                                     |                                     |                                            |
|--------|---------------------------------------------------------------------|-------------------------------------|--------------------------------------------|
| GAIN   | DC Voltage Gain (open loop)                                         | $R_L = 10K \Omega$                  | 100,000 (typ)<br>20,000 (min)              |
|        | Gain-Bandwidth Product                                              |                                     | 300 kHz (typ)<br>100 kHz (min)             |
|        | Gain Roll-Off                                                       |                                     | 6 db/octave (typ)                          |
|        | Slewing Rate                                                        |                                     | 0.2 V / $\mu sec$ (min)                    |
| INPUT  | Initial Equivalent Offset Voltage (adjustable to zero) <sup>1</sup> |                                     | 2 mV (max)                                 |
|        | Input Bias Current                                                  |                                     | 10 pA (typ)                                |
|        | Equivalent Drift vs. Temp (0-60°C) <sup>2</sup>                     |                                     | 50 pA (max)                                |
|        | Voltage Bias Current                                                |                                     | 50 $\mu V / ^\circ C$ (max)                |
|        | Drift vs. Supply                                                    |                                     | Doubles every 10°C                         |
|        | Equivalent Noise                                                    | 0.1 Hz to 10 Hz<br>10 Hz to 1 kHz   | 5 $\mu V$ p-p (max)<br>6 $\mu V$ rms (max) |
|        | Input Impedance Differential                                        |                                     | $10^{10} \Omega$ (min)                     |
|        | Common Mode                                                         |                                     | $10^{10} \Omega$ (min)                     |
|        | Common Mode Range                                                   | Supply $\pm 5V$<br>Supply $\pm 15V$ | $\pm 2V$ (min)<br>$\pm 12V$ (min)          |
|        | Common Mode Rejection                                               | 20 Hz                               | 66 db (min)                                |
| OUTPUT | Voltage Swing                                                       | $R_L = 10K \Omega$                  | $\pm 11V$ (min)                            |
|        | Load Current <sup>4</sup>                                           |                                     | $\pm 1$ mA (min)                           |
|        | Output Impedance (open loop)                                        |                                     | 5K $\Omega$ (typ)                          |
|        | Capacitive Loading (X closed loop gain)                             |                                     | 1000 pf (min)                              |
| POWER  | Supply Voltage Range                                                |                                     | $\pm 4.5$ to $\pm 20V$                     |
|        | Supply Current (quiescent)                                          | Supply $\pm 20V$                    | 200 $\mu A$ (max)                          |
| TEMP.  | Temperature Operating                                               |                                     | $-25^\circ$ to $+85^\circ C^3$             |
|        | Storage                                                             |                                     | $-55^\circ$ to $+125^\circ C$              |
| PRICE  | Price (1-9 pcs)                                                     |                                     | \$55.00                                    |
|        | ASO-2 Mating Socket                                                 |                                     | \$ 2.75                                    |

1. 10K to 50K $\Omega$  potentiometer supplied by user. If offset adjustment is not required, the "BAL" terminal may be left unconnected.
2. Averaged over specified temperature range.
3. For mil temperature range, consult factory.
4. Output protected from short circuits.

## FAIRCHILD CONTROLS

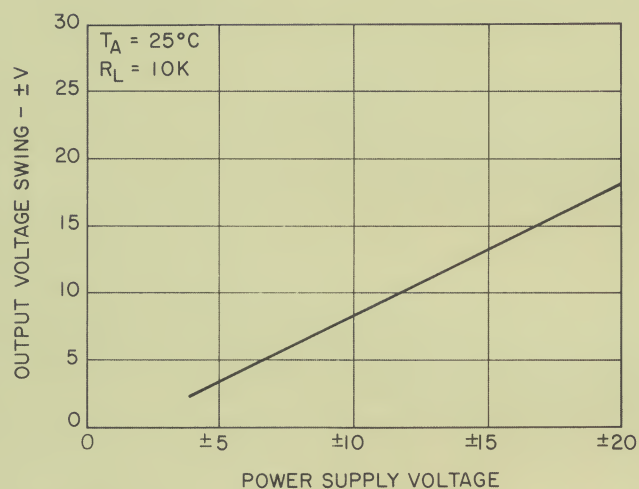
A Division of Fairchild Camera and Instrument Corporation  
Modular Products: 423 National Avenue  
Mountain View, Calif., 94040  
Telephone: (415) 962-3833  
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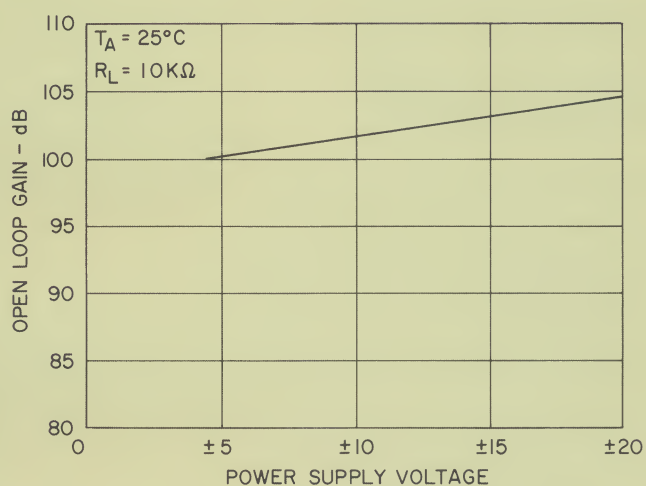


# LOW POWER FET OPERATIONAL AMPLIFIER/ADO-39

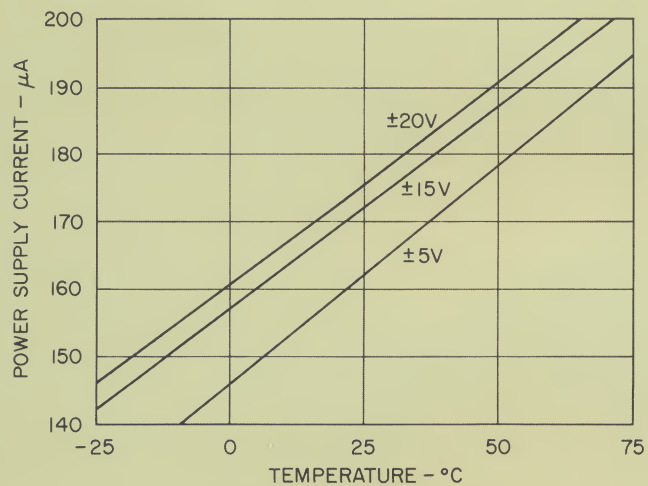
## TYPICAL PERFORMANCE



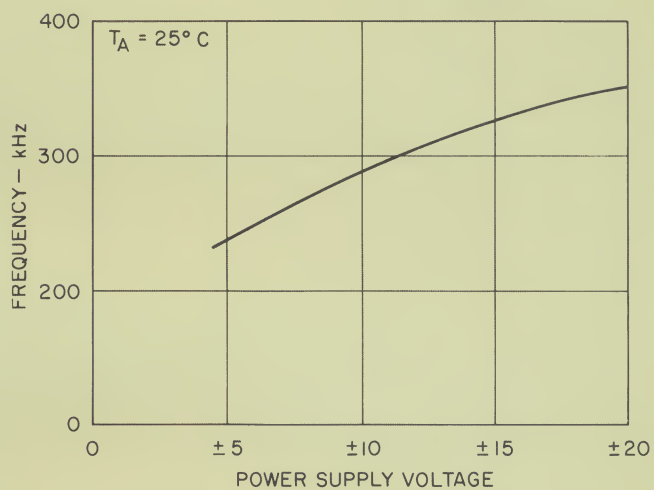
OUTPUT VOLTAGE SWING VS. POWER SUPPLY VOLTAGES



VOLTAGE GAIN AS A FUNCTION OF SUPPLY VOLTAGES



POWER SUPPLY CURRENT AS A FUNCTION OF TEMPERATURE



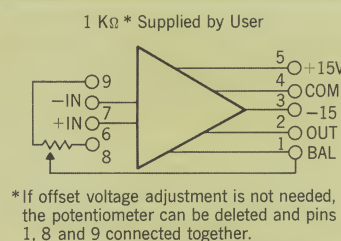
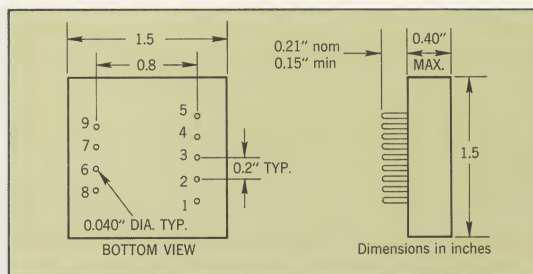
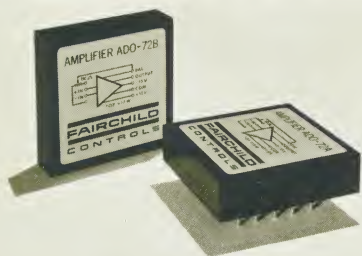
BANDWIDTH VS. SUPPLY VOLTAGES



0

**FAIRCHILD**

**CONTROLS**



- Ultra-low Drift  $0.5 \mu\text{V}/^{\circ}\text{C}$  (ADO-72A)
- High Gain 500,000
- High Common Mode Rejection 250,000:1
- Wide Power Supply Range  $\pm 6$  to  $\pm 20\text{V}$
- High Power Supply Rejection  $5 \mu\text{V}/\text{V}$
- Excellent Long Term Drift  $10 \mu\text{V}/\text{week}$  (typ)

These are high gain, high performance bipolar amplifiers with extremely low drift. The low noise, high common mode rejection, and excellent long term drift are particularly well suited for instrumentation applications involving low level signals and low source impedances. The power supply range,  $\pm 6$  to  $\pm 20V$ , and high power supply rejection,  $5 \mu V/V$ , allow the units to be operated from a variety of unregulated power sources with impunity.

Military temperature range versions are also available, write or call for specific details.

| Electrical Characteristics |                                                                     |                                   | Units                                      |
|----------------------------|---------------------------------------------------------------------|-----------------------------------|--------------------------------------------|
| GAIN                       | DC Voltage Gain (open loop) $R_L = 10K \Omega$                      |                                   | 2,000,000 (typ)<br>500,000 (min)           |
|                            | Gain-Bandwidth Product                                              |                                   | 800 kHz (typ)<br>400 kHz (min)             |
|                            | Gain Roll-Off                                                       |                                   | 6 db/octave (typ)                          |
|                            | Slewing Rate                                                        |                                   | 0.2 V / $\mu$ sec (min)                    |
|                            | Initial Equivalent Offset Voltage (adjustable to zero) <sup>1</sup> |                                   | 0.15 mV (max)                              |
| INPUT                      | Input Bias Current                                                  |                                   | 20 nA (max)                                |
|                            | Input Difference Current                                            |                                   | 20 nA (max)                                |
|                            | Equivalent Drift vs. Temp (0-60°C) <sup>2</sup>                     |                                   |                                            |
|                            | Voltage ADO-72A                                                     |                                   | 0.5 $\mu$ V / °C (max)                     |
|                            | ADO-72B                                                             |                                   | 1.0 $\mu$ V / °C (max)                     |
|                            | Bias Current                                                        |                                   | 0.5 nA / °C (typ)<br>1.0 nA / °C (max)     |
|                            | Difference Current                                                  |                                   | 0.1 nA / °C (max)                          |
|                            | Equivalent Drift vs. Time                                           |                                   |                                            |
|                            | Voltage                                                             |                                   | 10 $\mu$ V / week (typ)                    |
|                            | Bias Current                                                        |                                   | 5 nA / week (typ)                          |
| OUTPUT                     | Drift vs. Supply                                                    |                                   |                                            |
|                            | Voltage                                                             |                                   | 5 $\mu$ V / V (max)                        |
|                            | Bias Current                                                        |                                   | 0.25 nA / V (typ)<br>0.50 nA / V (max)     |
|                            | Equivalent Noise                                                    | 0.1 Hz to 10 Hz<br>10 Hz to 1 kHz |                                            |
|                            |                                                                     |                                   | 2 $\mu$ V p-p (max)<br>2 $\mu$ V rms (max) |
|                            | Input Impedance                                                     |                                   |                                            |
|                            | Differential                                                        |                                   | 600 K $\Omega$ (min)                       |
|                            | Common Mode                                                         |                                   | 600 M $\Omega$ (min)                       |
|                            | Input Voltage (max) <sup>3</sup>                                    |                                   |                                            |
|                            | Differential                                                        |                                   | $\pm 20$ V                                 |
| Common Mode                |                                                                     | +10 –12V (typ)<br>+9 –10V (min)   |                                            |
| POWER                      | Common Mode Rejection                                               | 20 Hz                             |                                            |
|                            |                                                                     |                                   | 114 db (typ)<br>108 db (min)               |
|                            | Voltage Swing                                                       | $R_L = 10K$                       | $\pm 12$ V (min)                           |
|                            | Load Current <sup>5</sup>                                           | $R_L = 2K \Omega$                 | $\pm 5$ mA (min)                           |
|                            | Output Impedance (open loop)                                        |                                   | 500 $\Omega$ (typ)                         |
|                            | Max Freq for full output                                            |                                   | 3 kHz (typ)                                |
|                            | Capacitive Loading (X closed loop gain)                             |                                   | 1000 pf (min)                              |
|                            | Supply Voltage                                                      |                                   |                                            |
|                            | (range)                                                             |                                   | $\pm 6$ to $\pm 20$ V                      |
|                            | (rated)                                                             |                                   | $\pm 15$ V                                 |
| Supply Current (quiescent) |                                                                     | 4 mA (typ)<br>6 mA (max)          |                                            |
| TEMP.                      | Temperature                                                         |                                   |                                            |
|                            | Operating                                                           |                                   | -25° to +85°C                              |
|                            | Storage                                                             |                                   | -55° to +125°C                             |
| PRICE                      | Price (1-9 pcs)                                                     |                                   |                                            |
|                            | ADO-72A                                                             |                                   | \$95.00                                    |
|                            | ADO-72B                                                             |                                   | \$80.00                                    |
|                            | ASO-2 Mating Socket                                                 |                                   | \$ 2.75                                    |

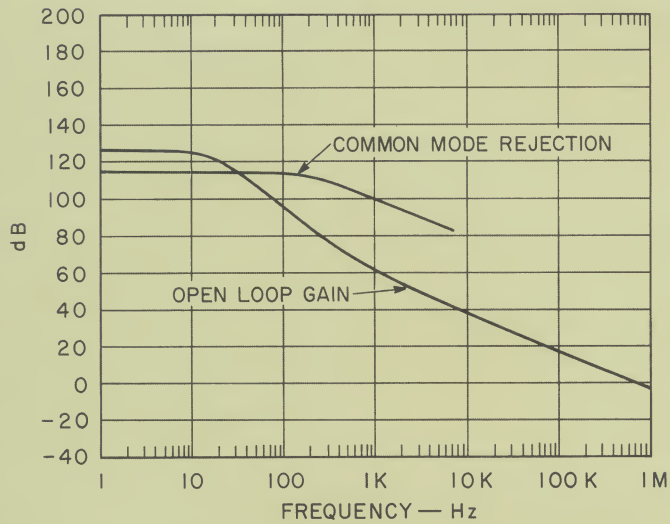
1. Offset measured with three offset terminals shorted.
2. Averaged over specified temperature range.
3. Input protection diodes.
4. For mil temperature range, consult factory.
5. Output protected from short circuits.

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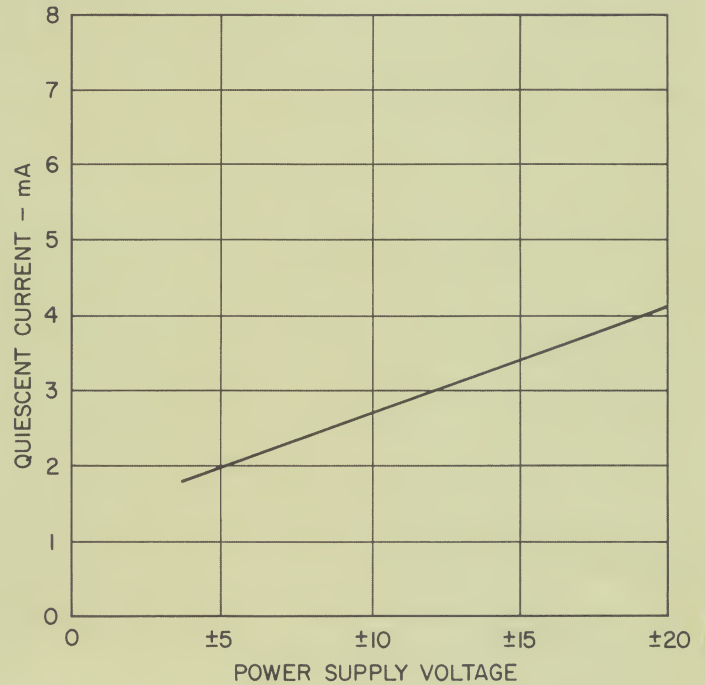
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# LOW DRIFT OPERATIONAL AMPLIFIERS / ADO-72A / B

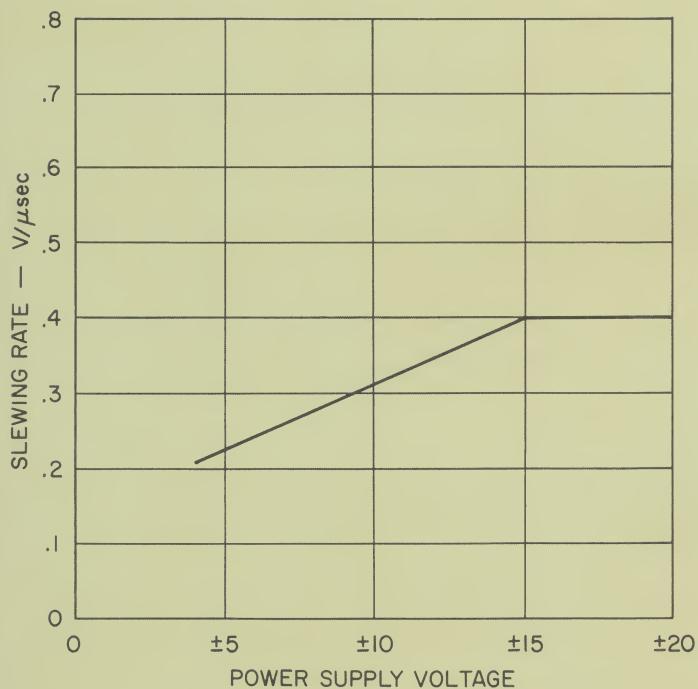
## TYPICAL PERFORMANCE



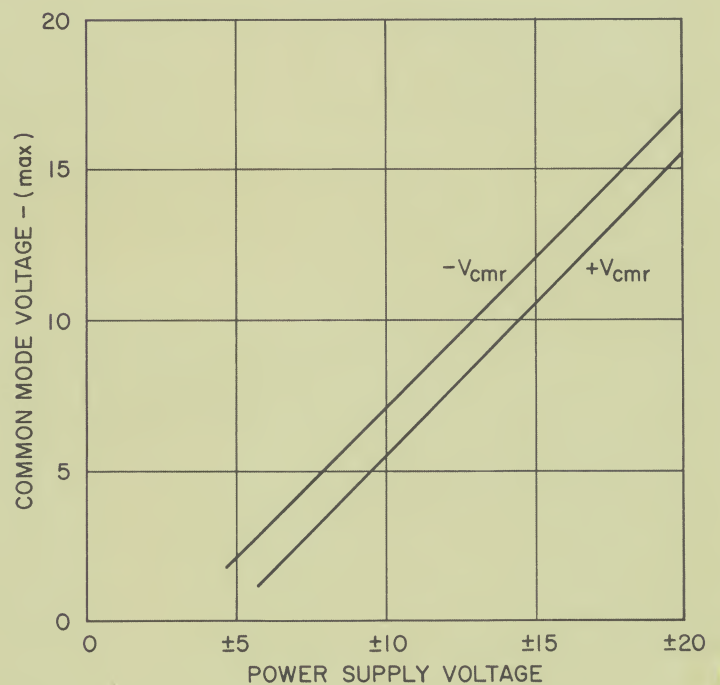
OPEN LOOP GAIN AND COMMON MODE REJECTION VS. FREQUENCY



QUIESCENT CURRENT VS. POWER SUPPLY



SLEW RATE VS. POWER SUPPLY



COMMON MODE VOLTAGE RANGE VS. POWER SUPPLY